

Contact tracing for SARS-CoV-2: what can be learned from other conditions?

Authors: James Brown,^A Kyle Ring,^B Jacqui White,^C Nicola E Mackie,^D Ibrahim Abubakar^E and Marc Lipman^F

ABSTRACT

Contact tracing is central to the public health response to COVID-19, but the approach taken has received criticism for failing to make enough of an impact on disease transmission. We discuss what can be learned from contact tracing in other infections, and how the natural history of COVID-19 should shape the strategies used.

KEYWORDS: COVID-19, contact tracing, public health

DOI: 10.7861/clinmed.2020-0643

Key points

- > Tracing contacts of cases of COVID-19 is key to ongoing control.
- > Significant experience exists within healthcare services of contact tracing for infectious diseases.
- > The natural history of COVID-19 requires specific approaches to contact tracing.
- > The sheer scale of the problem suggests that without effective technological support the UK approach may not succeed.

Introduction

Effective contact tracing is now central to the strategy to enable the UK to continue economic and social activities in the face of SARS-CoV-2 transmission and COVID-19 disease. The development and approval in the UK of effective vaccines that use different

approaches to generate protective immune responses raises hope for control of the pandemic. However, until these vaccines are rolled out to the country as a whole, contact tracing and prompt isolation of potentially infectious individuals may be the best way to avoid stringent curbs on normal life – particularly as the economic consequences of restrictions bite, and if public and political support wanes. Furthermore, the rapid spread of a new B.1.1.7 SARS-CoV-2 variant in the UK – which from first detection in September 2020 has circulated widely a few months later,¹ driving a second wave of infection starting in the South of England – demonstrates the importance of maintaining robust public health systems to control viral transmission.

Contact tracing is routinely used in the management of some infections transmitted from person to person where mechanisms exist to identify infected contacts and there are interventions to reduce onward transmission. This has been a successful control strategy in conditions as diverse as hepatitis C and tuberculosis (TB).^{2,3} Can lessons learnt from these diseases apply to COVID-19? Here, using the examples of sexually transmitted infections (STIs) and TB, we highlight the approaches that may help control COVID-19.

Sexual health services

Sexual health services utilise the skills of doctors, specialist nurses and health advisors to ensure that contact tracing is undertaken for all common STIs and HIV infection. Depending on patient preference, it can be anonymous, via physical contact slips, or employ texting and/or email via systems such as SXT.org.uk. Clinicians have taken creative approaches, including the use of social media and geolocal dating apps as a means of contact. Given the stigma around sexual infections and HIV, healthcare professionals ensure that clear information and careful explanation are provided to the potentially infected contact to stop further onward transmission with minimal distress.

While sexual health services have had considerable success in reducing STIs generally, there remain higher rates of infection in specific populations, such as Black Caribbeans, which underlines the challenges in reaching those who may be at greatest risk.⁴ Conversely, hepatitis C infection has been reduced through an effective micro-elimination strategy in HIV-positive men who have sex with men, and in those with less access to care such as the homeless and people with substance dependence problems.²

Authors: ^Aconsultant respiratory physician, Royal Free London NHS Foundation Trust, London, UK; ^Bspecialty registrar in HIV and genitourinary medicine, Imperial College Healthcare NHS Trust, London, UK; ^Cclinical team lead, North Central London TB Service, Whittington Health, London, UK; ^Dconsultant in HIV medicine, Imperial College Healthcare NHS Trust, London, UK; ^Eprofessor of infectious disease epidemiology, Institute of Global Health, University College London, UK; ^Fprofessor of medicine University College London, UK

Table 1. COVID-19, sexually transmitted infections and tuberculosis, and the approach to UK contact tracing

	COVID-19	Sexually transmitted infections	Tuberculosis (TB)
Biology of disease	Short incubation, rapid spread, little latency between infection and disease. Most infected individuals get symptomatic disease, asymptomatic individuals can be infectious	Varied biology with different infections. Most transmission by symptomatic individuals, but high infectivity may be early in disease with minimal symptoms (eg primary HIV infection and seroconversion)	Most exposed individuals are not infected; most infected individuals do not get symptomatic disease
Knowledge of disease and control measures	Novel pathogen, rapidly evolving understanding of pathology and treatment options	Conditions well understood, multiple methods of prevention and treatment generally available	Long history of research into disease, transmission and treatments
Mechanism of spread	Short exposure for infection (minutes). Believed to be primarily droplet-spread, although role of airborne transmission and contaminated surfaces unclear	Sexual contact	Primarily aerosol. Prolonged (>8 hours) contact required for transmission
Interventions to prevent transmission	Contact tracing with isolation reduces onward transmission. No specific treatment available to prevent onward transmission	Identification of cases can allow preventative measures (eg condoms) Treatment of conditions prevents onward transmission (eg use of antiretroviral therapy for HIV)	Contact tracing detects incident disease, & latent (asymptomatic) infection Treatment of TB disease and latent TB cures or prevents disease, and reduces further transmission
Contact tracing approach	Contact tracing by large workforce (but mostly with less specialist skill-set), largely independent of NHS public health services	Anonymous tracing often used, national electronic system within NHS	Person-to-person, networks of skilled professionals within NHS
Infrastructure	Newly created structure with significant private sector input	Sexual health services part of health system, although with sensitive data not shared with other health systems	Built within NHS networks

Tuberculosis

In TB services, contact tracing utilises a network of highly experienced specialist nurses and support workers. Household contacts of cases of pulmonary or laryngeal TB are contacted, asked about symptoms of TB disease, and offered testing for latent TB infection. Extended testing and tracing (for instance in schools or workplaces) may be undertaken where there is concern about possible transmission. This is achieved by a multidisciplinary team including specialist nurses, doctors, public health officials and community support workers. The identification and testing of contacts relies on the personal relationship and trust that TB service users have in these individuals – an essential requirement where people may feel that their medical details could be disclosed to others to benefit public health. Case management and contact tracing is overseen by a system of ‘cohort review’ (involving public health and TB services) of all cases of TB disease and their possibly infected contacts. This allows regular, open evaluation

of its effectiveness, and opportunities for national improvement and uptake. Experienced health professionals work closely with a specialist laboratory network to utilise mycobacterial whole-genome sequencing (WGS) to help identify chains of transmission (identified by closely related TB isolates) using detailed molecular epidemiology.⁵ Similar approaches have yielded important information on outbreak clusters and routes of transmission for SARS-CoV-2.^{6,7}

How does SARS-CoV-2 differ from other infections where contact tracing is used, and why does this matter?

Similarities and differences exist between SARS-CoV-2 and other infections (Table 1). Disease natural history determines the speed of the response required to prevent ongoing transmission. For TB and some sexually transmitted infections, including syphilis and blood-borne viruses such as hepatitis C, there is a relatively long timeframe (often

weeks to months) between infection acquisition and risk of transmission to others through disease onset. This provides greater opportunity for contact tracing and intervention.⁸ However, as individuals can transmit SARS-CoV-2 when asymptomatic,⁹ effective contact tracing must be performed promptly to avoid a much larger network of potentially secondarily infected contacts at risk of COVID-19 needing identification and assessment. The increased transmissibility of the B.1.1.7 SARS-CoV-2 variant in the UK has raised the bar further for contact tracing services, who now encounter large numbers of individuals infected from a single source – all of whom need their own management and assessment for secondary cases.

It is also worth considering what constitutes a ‘contact’. Sexual contact is usually easily defined, but a century or more of research is still trying to determine how much exposure to TB disease is required to make contact tracing of value.¹⁰ For SARS-CoV-2 the length and type of contact necessary for transmission is even less certain, although evidence from other airborne viruses such as influenza may be informative.¹¹ What is clear is that exposure can be brief, such that a general definition of a contact is someone who has spent more than 15 minutes at a distance of less than 2 metres from a case of COVID-19.¹²

Contact tracing for SARS-CoV-2

The aim of contact tracing is to identify social and household contacts exposed to, and possibly infected with, SARS-CoV-2, and get them to self-isolate. The success of systematic contact tracing as part of the response to SARS in 2003 encouraged its use in managing COVID-19.¹³ It has been incorporated within the national public health strategies of several countries that achieved prompt SARS-CoV-2 outbreak control, including Singapore, Taiwan and Vietnam.^{14–16}

What about the UK? After a 10-week pause when the country was in the first national lockdown, contact tracing recommenced on the 28 May 2020 to be delivered by a large, new workforce, with considerable private sector input, in particular in England. This was initially set up to operate separately from existing NHS and local authority systems.¹⁷ The procedure is as follows: if someone tests positive for SARS-CoV-2, they are asked to share details of their close contacts, who are then instructed to self-isolate. This is carried out mainly by telephone, by staff who are not necessarily clinically trained.

The challenges facing the NHS Test and Trace Service are significant. Firstly, most cases of COVID-19 are not coming to the attention of the healthcare system at all, as highlighted by the discrepancy between the estimated number of cases from the population-based ONS survey and reported numbers of cases from Test and Trace. For instance, for the week 15–21 November, ¹⁸ ONS estimated that there were 633,000 cases in England, whereas only 152,660 cases were reported by Test and Trace for the similar period of 12–18 November 2020.¹⁹ Once cases of COVID-19 are identified and details transferred for contact tracing, there are also significant losses: in the week of 12–18 November, only 85 % of individuals with COVID-19 referred to Test and Trace were contacted, and of the contacts identified 60 % were then reached and instructed to self-isolate.¹⁵ This compares poorly with, for instance, contact tracing for TB, where 91 % assessed for contact tracing in London at least one contact, 86 % of whom were then evaluated for active or latent TB.³ Evidence provided to the government’s SAGE committee in September described the impact of contact tracing on the transmission of COVID-19 as ‘marginal’.²¹

The National Audit Office report that reviewed the English NHS Test and Trace Service up to October 2020 concluded that the

Government had achieved an admirable scale-up of tracing capacity over a short time, though it had not reached its stated aim of providing results within 24 hours for tests carried out in person in the community (Pillar 2 tests). There was a lack of a clear strategy to enable local and national tracing teams to work together effectively, and the basis for its delivery model was unclear, with a risk of limited accountability and poor value for money.²¹ The report is the first of two, with the second one (due in spring 2021) providing a more detailed economic assessment of the service.

As, unlike TB or some sexually transmitted infections, there is no current treatment that can prevent COVID-19 disease after exposure, effective self-isolation is essential to avoid the risk of onward transmission. How likely are people to adhere to instructions to do this – particularly if they do not perceive themselves to be at risk (even when they have symptoms), or feel well, or face threats to their employment if made to stop work? The answer seems to be not much; a recent study by King’s College London suggests that less than 11 % of people asked to quarantine following being alerted as a contact of a confirmed COVID-19 case complied with the request.²² Much of this is believed to result from many feeling that they cannot afford to stay at home and not work. To mitigate the financial impact the Government has introduced a payment scheme for people who need to self-isolate and cannot work from home.²³ Apart from the instruction to self-isolate, contact tracing for SARS-CoV-2 does not provide practical assistance, such as ensuring that essentials such as food are considered and supported.

Issues with SARS-CoV-2 contact tracing in the UK

To be successful, the UK strategy requires both public trust and widespread acceptance. This will be more easily achieved if built on existing experience. An important early issue with the Test and Trace strategy in England was the poor linkage of laboratories testing for SARS-CoV-2 to local NHS services and local authorities. During an outbreak of cases in Leicester in June 2020 it became clear that ‘Pillar 2’ data – from commercial laboratories processing drive-through tests and home testing of the general public – were not being released to local authorities. The upsurge in numbers was only apparent some time later once these data were reviewed. Earlier identification of a local increase in cases could have avoided the ‘return to lockdown’ that was then put in place. Once recognised, attempts have been made to improve the communication between the Test and Trace service and local health protection teams.²⁴ How this will work when mass population testing using rapid antigen assays is rolled out nationally remains to be seen.²⁵

Is technology the answer?

The work involved in running a national contact tracing service is considerable. Technology, seen as crucial to the success of a coordinated strategy, is being actively pursued by many countries. In the UK a smartphone app has been introduced. This is less ambitious than was originally proposed, and has been reported to have been downloaded 19 million times (although this is estimated to equate to only 40 % of smartphone users).²⁶ For new technology to be effective high population uptake is needed – yet many individuals might prefer human interaction to impersonal instructions from a computer app when it comes to their healthcare decisions.

The reliance on technology could be problematic, as the people most at risk of COVID-19 – elders, those with comorbidities, ethnic minorities, and economically disadvantaged communities – may

be least able to access the technology. Such groups can also have concerns about information held in a national database, with significant private-sector input. Data protection issues that arise from contact tracing have already been raised by the Information Commissioner's Office. This has been a problem in other countries such as Korea, where privacy concerns were highlighted, particularly for the lesbian, gay, bisexual and transgender (LGBT) community, by tracing and testing of attendees of night clubs in Seoul following a cluster of cases.

Given that black and ethnic minority populations are at greater risk from COVID-19 disease, it is imperative that contact tracing also involves culturally sensitive strategies that do not raise further barriers to care and so exacerbate existing health inequalities.

Conclusion

The rapid creation of a national contact tracing system for SARS-CoV-2 is to be applauded. In the UK, its performance can be expected to improve further as experience grows and capacity increases. Useful lessons can be drawn from other infectious diseases: a contact tracing system that is better integrated with other services, including health and social care (particularly primary care), and effectively utilises established public health services and local authorities would be more responsive to the needs of local populations. It would also be able to offer the user more value from being contact traced than just being instructed to self-isolate. This could include providing relevant local information, messaging and support (things that appear to improve adherence to self-isolation for COVID-19). The data collected need to be rapidly available to local teams, and the capacity must exist to ensure that people most at risk of COVID-19 are both suitably informed and adequately protected. ■

References

- Public Health England. *Investigation of novel SARS-CoV-2 variant. Variant of Concern 202012/01: Technical briefing 2*. PHE, 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/948152/Technical_Briefing_VOC202012-2_Briefing_2_FINAL.pdf.
- Katzman C, Mateu-Gelabert P, Kapadia SN *et al*. Contact tracing for hepatitis C: The case for novel screening strategies as we strive for viral elimination. *Int J Drug Policy* 2019;72:33–9.
- Cavany SM, Sumner T, Vynnycky E *et al*. An evaluation of tuberculosis contact investigations against national standards. *Thorax* 2017;72:736–45.
- Mohammed H, Blomquist P, Ogaz D *et al*. 100 years of STIs in the UK: a review of national surveillance data. *Sex Trans Infect* 2018;94:553–8.
- Lalor MK, Casali N, Walker TM *et al*. The use of whole-genome sequencing in cluster investigation of a multidrug-resistant tuberculosis outbreak. *Eur Respir J* 2018;51:1702313.
- Oude Munnink BB, Nieuwenhuijsen DF, Stein M *et al*. Rapid SARS-CoV-2 whole-genome sequencing and analysis for informed public health decision-making in the Netherlands. *Nat Med* 2020;26:1405–10.
- Rockett RJ, Arnott A, Lam C *et al*. Revealing COVID-19 transmission in Australia by SARS-CoV-2 genome sequencing and agent-based modeling. *Nat Med* 2020;26:1398–404.
- Behr MA, Edelstein PH, Ramakrishnan L. Revisiting the timetable of tuberculosis. *BMJ* 2018;362:k2738.
- He X, Lau EH, Wu P *et al*. Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nat Med* 2020;26:672–75.
- Reichler MR, Khan A, Yuan Y *et al*. Duration of exposure among close contacts of patients with infectious tuberculosis and risk of latent tuberculosis infection. *Clin Infect Dis* 2020;71:1627–34.
- Hayward AC, Fragaszy EB, Bermingham A *et al*. Comparative community burden and severity of seasonal and pandemic influenza: results of the Flu Watch cohort study. *Lancet Respir Med* 2014;2:445–54.
- Public Health England. *Guidance for contacts of people with confirmed coronavirus (COVID-19) infection who do not live with the person*. www.gov.uk/government/publications/guidance-for-contacts-of-people-with-possible-or-confirmed-coronavirus-covid-19-infection-who-do-not-live-with-the-person/guidance-for-contacts-of-people-with-possible-or-confirmed-coronavirus-covid-19-infection-who-do-not-live-with-the-person [Accessed 14 December 2020].
- Riley S, Fraser C, Donnelly CA *et al*. Transmission dynamics of the etiological agent of SARS in Hong Kong: impact of public health interventions. *Science* 2003;300:1961–6.
- Pham TQ, Rabaa M, Duong LH *et al*. The first 100 days of SARS-CoV-2 control in Vietnam. *Clin Infect Dis* 2020, in press (DOI: 10.1093/cid/ciaa1130).
- Pung R, Chiew CJ, Young BE *et al*. Investigation of three clusters of COVID-19 in Singapore: implications for surveillance and response measures. *Lancet* 2020;395:1039–46.
- Cheng HY, Jian SW, Liu DP *et al*. Contact tracing assessment of COVID-19 transmission dynamics in Taiwan and risk at different exposure periods before and after symptom onset. *JAMA Intern Med* 2020;180:1156–63.
- Department of Health and Social Care. *Experimental statistics – weekly NHS test and trace bulletin, England: 28 May to 10 June 2020*. DHSC, 2020. www.gov.uk/government/publications/nhs-test-and-trace-statistics-england-28-may-to-10-june-2020/experimental-statistics-weekly-nhs-test-and-trace-bulletin-england-28-may-to-10-june-2020 [Accessed 14 December 2020].
- Office for National Statistics. *Coronavirus (COVID-19) infection survey, UK: 26 November 2020*. ONS, 2020. www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/coronaviruscovid19infectionsurveys/pilot/26november2020 [Accessed 14 December 2020].
- Office for National Statistics. *Weekly statistics for NHS Test and Trace (England) and coronavirus testing (UK): 12 November to 18 November*. ONS, 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/939110/Test_and_Trace_Week25.pdf [Accessed 14 December 2020].
- Scientific Advisory Group for Emergencies. *Summary of the effectiveness and harms of different non-pharmaceutical interventions, 21 September 2020*. SAGE, 2020. www.gov.uk/government/publications/summary-of-the-effectiveness-and-harms-of-different-non-pharmaceutical-interventions-16-september-2020 [Accessed 14 December 2020].
- Department of Health and Social Care. *The government's approach to test and trace in England – interim report*. National Audit Office, 2020. www.nao.org.uk/wp-content/uploads/2020/12/The-governments-approach-to-test-and-trace-in-England-interim-report.pdf [Accessed 14 December 2020].
- Smith LE, Potts HWW, Amlot R *et al*. Adherence to the test, trace and isolate system: results from a time series of 21 nationally representative surveys in the UK (the COVID-19 Rapid Survey of Adherence to Interventions and Responses [CORSAIR] study). *medRxiv* 2020. www.medrxiv.org/content/10.1101/2020.09.15.20191957v1 [Accessed 14 December 2020].
- Citizens Advice. *Coronavirus – getting benefits if you're self-isolating*. www.citizensadvice.org.uk/benefits/coronavirus-getting-benefits-if-youre-self-isolating/ [Accessed 14 December 2020].
- Department of Health and Social Care. *NHS Test and Trace service to strengthen regional contact tracing*. DHSC, 2020. www.gov.uk/government/news/nhs-test-and-trace-service-to-strengthen-regional-contact-tracing [Accessed 14 December 2020].
- Department of Health and Social Care. *Community testing to help lift restrictions in highest tiers*. DHSC, 2020. www.gov.uk/government/news/community-testing-to-help-lift-restrictions-in

- highest-tiers [Accessed 14 December 2020].
- 26 Langford E. The NHS Covid-19 app has only had half the downloads NHS Advisors say it needs to help stop the coronavirus pandemic. *Politics Home*, 29 October 2020. www.politicshome.com/news/article/nhs-covid19-app-users-downloads-coronavirus-pandemic-40-80 [Accessed 14 December 2020].

**Address for correspondence: Professor Marc Lipman,
Respiratory Medicine, Royal Free Hospital, Pond Street,
London NW3 2QG, UK
Email: marclipman@nhs.net**